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ABSTRACT

Though recent decades have witnessed radical changes in the nature of the society, technology offers a way for schools to continue providing quality educational services. The combination of rapidly changing constituencies, an emphasis on cost-effectiveness, and the trend toward individualized learning presents educational needs that can be filled using computer-based instruction and administration. This report summarizes current trends in computer-based education, including descriptions of four programs: (1) Minnesota Educational Computing Consortium; (2) Control Data's feasibility study; (3) Special Learning Disabilities Project; and (4) Law Enforcement Assistance Agency Project. (EMH)

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COMPUTER BASED EDUCATION: AN APPROACH TOWARD ADAPTIVE LEARNING PROCEDURES

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Some weeks ago, while visiting in a school district in Northern Minnesota, I had the opportunity to slip into the rear of a high school social studies classroom unannounced. As I looked around the room and listened to the presentation being given by the teacher, the setting was very familiar. The chairs were arranged in the same orderly fashion; the open textbooks in front of the students; the outline of the current topic of discussion written on the chalkboard with outside reading references; and the teacher discussing some of the very same points I had heard 27 years earlier when I was a student in a high school social studies class.

During those years truly amazing changes have taken place in the world. Television has become the major media of communication - happenings are now viewed throughout the world via satelite simultaneously with their occurrence. Space exploration is giving us new information and data about the universe. We can travel between continents in a fraction of the time required in the 1950's by a supersonic transport system. Food production has increased dramatically with the use of new fertilizers, and new hybrid strains of seeds. And the use of computer technology has given us the tools to assimilate and retrieve information, to explore, to predict, and to resolve problems with greater speed and accuracy than ever dreamed possible only a few decades ago.

It is the contrast between these two illustrations that I want to discuss with you today. More is demanded of schools in the United States than ever before in the 200 year history of our Nation; yet, the educational

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procedures and practices in our schools have not kept stride with the demands. We have a "horse and buggy" educational system attempting to keep pace with a "jet age" world. It simply will not work.

As I work with education on a local, state, and National level, I am firmly convinced that -

- Some radical and dramatic changes in the educational process are essential to the growth and productivity of our society.
- Education - that is, the learning process, must fully utilize the technology available today, and demand more extensive development where and when necessary.
- These changes will require a coalition between the educational system and the corporate structures of our Country - a working relationship bonded together by a commitment to quality educational opportunities for all students.

Before going further in our discussion of technology's role in education, let's take a moment to examine the characteristics of the educational system in the United States. First of all, it is not a system at all. It is a non-system composed of 16,300 school districts, each with varying degrees of authority and responsibility as determined by the 50 states and 8 outlying areas in which these school districts operate.

The responsibility for education was delegated to State and local governments in the Constitutions of the United States. It is the only area of human services in which the Federal government does not have some direct control over content and procedure. We have never been concerned about decentralization of education because it has never been centralized.

This concept has both it's strengths and difficulties. State and local administration of the schools requires an active participation by all citizens. Curricular programs can be directed at specific local and state needs. On the other hand, total decentralization makes systemic change more difficult. It is this difficulty that precipitates the role of the Federal government in education.

By directing Federal funds toward educational programs of National concern, the State and locally supported school districts tend to respond to these needs. A National agricultural education program was initiated in 1917, when the rural to city migration created a shortage of farm labor. Vocational education programs were to be supported by Federal funds to provide trained personnel for the jobs created in our developing society.

More recently, Federal resources have been directed toward specific student needs; programs for handicapped children, enrichment programs for the educationally disadvantaged student, and bilingual education for children coming from homes where English is not spoken.

In addition to meeting a multitude of educational needs of different students, other societal concerns have been directed to the schools to remedy. When the use of drugs and alcohol became more prevalent, school districts throughout the Nation responded to the urging and requests of their communities to initiate drug abuse programs.

Environmental concerns have prompted school districts to initiate programs in energy conservation and the care and protection of natural resources. Sex education, family living, cultural heritage, human relations, communications, and many other areas of concern are now represented in the elementary and secondary school curriculum because of societal needs.

One other factor cannot be omitted from the responsibilities heaped upon the schools. As well as an educational institution and an agency to bring about change in or support of community concerns, the schools are also expected to be the hub of social activities. The time and resources direct toward this purpose through inter-scholastic activities in athletics and cultural development in the arts and humanities tend to detract from the school's responsibility in basic education.

Let me hasten to add that these segments of school activity are not necessarily bad in and of themselves. But schools in America have had a tendency to become social institutions where some degree of learning may take place.

While the community demands this plebian role for the schools as a social institution, they are critical of the school's inability to respond to the educational needs of young people. We have come to a point in time where we must tell the public what we can and what we can't do in our schools. In the areas of reading and computational skill development we can and should be accountable for the results. The other operational areas must be examined and evaluated carefully to determine their priority and value in the educational program. The schools must not be diverted from their primary purpose of educating young people.

A Changing Constituency

The schools have undergone at least three major transitions in the United States during the past 50 years. Until the 1930's, the Country was basically a rurally oriented society. The number of high school graduates represented fewer than 30% of the population. Basic reading and computational skills were provided through the eighth grade, and these skills met the needs of most young people. The movement toward industrialization demanded additional skills and the high school graduate became more in demand.

As the need for professional and technical services increased, college and university enrollments began to grow. But even at the midpoint of the century, fewer than 50% of the Nation's youth were graduating from high school.

Today, all states have compulsory education laws, many of which require students to remain in school until age 16 or through the eighth grade. Those students of lesser ability or who experienced any kind of learning problem, previously left school to learn a trade or seek employment. In the State of Minnesota 92.4% of the students, after completing 13 years of education, graduate from high school.

The technical demands of the society in which we live demand an educated citizen. Those students with learning problems or lesser ability can no longer leave school with the assurance they can be meaningfully employed. Many vocational training programs require the completion of high school to enroll.

No student in the United States of America can be denied an education because of physical, mental, or emotional problems. Many states have enacted laws to this effect, and more recently a Federal law requires all states and school districts to provide for the special needs for the education of handicapped children, whatever they may be.

Visualize with me, the variety of educational needs that might exist in a typical high school in Minnesota or elsewhere in the U.S..

* A 50-50 boy/girl ratio with the Federal requirement that no educational or social limitations shall be based on the sex of an individual.
* A racial mixture of 2,3 or more different ethnic and cultural backgrounds.

* Any where from 20 to 40% of the students with reading and computational skills below their current grade level.
* Some 17% of the students hindered by some degree of physical, mental or emotional handicap.
* Students will come from all socio-economic backgrounds - common and skilled laborers, highly educated professional parents, businessmen, one-parent homes, foster homes, community correctional facilities, and many others.
* Some 15% of students can be classified as gifted or high achievers who learn twice as much in half the time it takes other students.
* Many students have part time jobs, either as a part of a work-study program in the school or after school hours.
* And finally that large group of students we call "average" who may also have special needs from time to time.

Every teacher is responsible for instructing a heterogeneous grouping of students with these characteristics. Principals are responsible for scheduling and administering an educational program where all of these students will achieve and progress.

In a traditional school setting where alternative paths for students with different backgrounds and talents are restricted, the extent of learning is severely limited. Dr. Robert Glasser identifies this approach as a "selective educational mode," as opposed to the "adaptive educational mode" which "assumes that the educational environment can support many and varied instructional methods and opportunities for success". The extent to which our educational system is successful with these demands and constraints, never ceases to amaze me.

Time, Instructional Costs and Efficiency

Three other important factors which impinge on the educational process must be considered at this time. These factors are:

* The wise and expeditious use of teacher time.
* The limited time of student/teacher contact.
* The rapidly increasing cost of instruction via teacher and administrators salaries.

In a typical classroom setting, the instructional approach is directed slightly below the median of the student achievement level. This means that for 20 to 30% of students the lesson will be repetitive and not challenging. These students will not be using their capabilities to their potential, misusing both student and teacher time. Frequently, discipline problems occur in this situation.

The 10 to 15% on the lower end of the spectrum are frustrated in their inability to achieve, even at the slower rate of instructional presentation. For these students, the school and education takes on negative connotations that nurture poor attitudinal characteristics and drastically reduces their self-esteem.

This leaves about 55% of the students for whom the lesson and presentation is appropriate; however, difficulties with the other students reduce teacher effectiveness even more.

Educational costs have skyrocketed in the past ten years. In the 1964-65 school year $26.7 billion were spent for education in the elementary and secondary schools. By the 1974-75 school year, the costs had increased to $68.2 billion. This represents an increase of 155% in ten years. In Minnesota total per pupil expenditures increased 26% in the two years between 1973 and 1975, from $1,143 to $1,442. Preliminary data shows these costs are increasing at a similar rate in succeeding years.

It is not unusual to see teacher salaries at $22 to $23 thousand for staff with 10 to 12 year's experience and university credits past the Master's Degree level. With 82% of the total education dollar being spent on personnel salaries, more effective use of teacher time must be made to even maintain the current quality of education.

Our concern then becomes, How can we make student/teacher contacts more productive. What approaches, methods, and techniques can be employed to most effectively utilize the skills and expertise of the teacher?

Individualization of Instruction

We all speak rather flipantly about individualization of instruction without acknowledging the careful planning and management practices that the concept employes. Also, we often forget how far we must come from a "one teacher - 30 students - one approach system" to a "one teacher - 30 students - 30 approach system." This is individualization in its ultimate form.

Let's look further now at the various components of an individualized instructional program. You must begin with staff training because the teacher ceases being the authority figure imparting knowledge on his willing subjects, and becomes a classroom manager and an educational consultant to his students.

Planning and organizational abilities are vital to the process. These are new areas of concern for teacher preparation institutions. Very few colleges prepare their future teachers to plan and organize classroom activities effectively.

Teachers must become educational entrepreneurs in the classroom; capable of saying the same thing in many different ways; to have one more approach for the student not succeeding; providing the word of encouragement when needed; being the stern taskmaster when appropriate; manipulating an educational delicatessen especially designed for its nutritional benefits.

"Diagnostic and prescription approach" is another term lightly used, but a vital component in the individualization process, and includes:

* the identification of skills to be attained.
* the assessment of student competencies and weaknesses.
* the designation of instructional approaches to match learner needs.
* the continuous measurement of student progress.
* the evaluation of the process.
* the recycling of the procedure when necessary with appropriate modification.

To me, "individualized instruction" connotes "mastery learning." It's neither a concept nor a process in and of itself, but rather a concept that requires a process. It is the great humanizing factor in education, because failure is no longer possible. All students now succeed; some at a faster or slower rate than others, but all learn and all succeed.

If one of our children has more difficulty in learning to tie his shoe, and does not accomplish this task until he is six years old, we do not label the child as a failure. We know that, barring any specific physical problems, he will be able to accomplish this task as his manipulative skills develop.

This is what the educational process should be and we've known this for 50 years. What we haven't had is the administration and management capabilities and leadership to implement the procedure necessary to make it work. Today we have these capabilities - but they take time - teacher time and administrator time - to implement.

But there's another kind of time available - and that's computer time. As a management tool it is more accurate, quicker and tireless in its efforts to provide immediate access to information about student needs and progress. As an instructional tool it provides those new approaches for individual students. As a data storage and retrieval system it gives immediate feed-back for teachers to direct student learning. Computer time provides teacher time for student interaction.

New Partnership in Education

The educational use of computer technology requires the formation of new partnerships. The schools need technical assistance and expertise of the private sector - and the private sector needs educational awareness - and business of the schools. Teacher training institutions must be involved to understand the characteristics of teachers who will be employed in a quite different educational setting.

State government provides leadership, coordination and initiation through the Department of Education and the Minnesota Educational Computing Consortium. Research and demonstration funds have been provided by the Federal government to encourage new approaches to meeting the educational needs of children and youth.

Twenty-five members of the Minnesota Department of Education staff are undergoing intensive training in courseware authorship to enable them to use computer technology in the attainment of educational objectives. The State Legislature appropriated more than $5 million last year to assure the equal access to computer services that are available to the metropolitan school districts.

The following briefs describe some of the operational programs and efforts being conducted in Minnesota.

Minnesota Educational Computing Consortium

In an effort to coordinate and support the use of computers in Minnesota education, an agency known as the Minnesota Educational Computing Consortium (MECC) was created. The Consortium includes as members the State Department of Education and Administration, the University of Minnesota, the State University and Community College Systems. In addition to having authority to review and approve computer hardware, the Consortium operates a statewide instructional timesharing system. Currently, over 1,300 terminals - linked to a variety of computers - are operational in the state. Over 90 percent of all public school students have access to a computer from a terminal located in their school districts. The Instructional Services Division of MECC has Instructional Computer Coordinators serving educators in all parts of the state.

Under a contract from the National Institute of Education's Office of Finance and Productivity, the Division is conducting a study of the impact of computers in education. Their goal is to determine what impact computers are having in administrative and instructional processes. The project, currently completing the design phase, is scheduled to begin the data collection phase in late September. The staff has developed a number of evaluation techniques and instruments which could be used. Because staff members have given much thought to the assessment of computer impact in education, they would be a valuable resource as consultants.

The Special Projects Division is also engaged in a project to test the effectiveness of computer assisted instruction in juvenile correctional facilities. Working with the Minnesota Department of Corrections, the staff is helping implement the use of the PLATO system at the Training School at Red Wing, and the use of courseware developed by Dr. Patrick Suppes (made available through Computer Curriculum Corporation) at the Home School in Sauk Centre. As a result of their experience the staff has become very familiar with the PLATO system and its courseware and also with the CCC system and its curriculum packages.

As the corporate parnter in several Minnesota computer based education projects. Control Data has contributed generously of staff time to educational efforts in the State and throughout the world. In a recent proposal to the U.S. Department of Health, Education and Welfare, they described their corporate mission as follows:

> Control Data is a worldwide business dedicated to the improvement of productivity and the quality of life for individuals and organizations through the application of its computer technology, financial resources and professional services. Rather than operating as an independent business enterprise, Control Data decided to seek cooperative arrangements with other organizations in order to pool resources and thereby reach the goals of improved productivity and improved quality of life more quickly and effectively.

Basic to Control Data's definition of the "improvement of the quality of life" is the improvement of educational opportunities. A recent restructuring of the Corporate System gives special emphasis to their involvement in education and confirms the high priority placed on the newly formed Minnesota Consortium. Control Data's commitment to education and to the application of computer technology to education began in 1961. The first step was the sale of large scale computers to educational institutions, accompanied by research grants. In 1962, the company began establishing computer service centers in the belief that numerous applications of computers, including many for education, would eventually be achieved on a service basis rather than by selling or leasing the computers to users.

The major tool for educational application is the CDC PLATO system. PLATO, Programmed Logic for Automated Teaching Operations, is perhaps the best computer based education system in the world. It has been developed over the past 10 years by a dedicated staff of educators and scientists whose efforts have been directed toward using the computer and its associated equipment to assist in the teaching process and to provide more individualized instruction. As a result, PLATO is the most advanced system developed for education purposes. Control Data has contributed substantial human and fiscal resources to the educational as well as to the technological development of the PLATO system.

Given this framework of corporate commitment, social responsibility, and technological expertise, Control Data has sought out new opportunities to further expand the capabilities of the CDC PLATO system by assisting in making a quality education available to more people. Control Data's willingness to respond directly to the unique demands of education systems has made this working relationship truly exciting.

Control Data Feasibility Study

In 1974, Control Data initiated a limited study with two special education coordinators from the Bloomington Public School System in Bloomington, Minnesota. The study examined the feasibility of transferring portions of the language arts curriculum (developed by the coordinators for learning disabled students in their schools) to the Control Data PLATO system.

A lesson on syllabication was developed and implemented. By using different levels of difficulty for words stored in the dictionary, the lesson can be used by all levels of elementary andjunior high students. The lesson operates totally from the touch panel, requiring the keyboard only for initial "sign-on" procedures. The study also developed a teacher's planbook where parameters for lessons can be entered. The dictionary includes lists of words from the cirriculum as well as an option for the teacher to enter his/herown words. The conclusion offered by the project staff was that it was not only possible, but also highly desirable, to have certain lessons and management functions enhanced by CBE technology.

Special Learning Disabilities Project

In December, 1975, an announcement of grants available for special projects in the education of children with special learning disabilities was initiated by the Bureau of Education for the Handicapped. In a combined effort, the State Department of Education submitted a proposal along with Control Data Corporation, the State Department of Corrections, and selected local school districts.

The proposal calls for a 36-month period of activity, during which a reading curriculum will be selected, designed for computer application, developed and demonstrated in a publically accessible Demonstration Center as well as in various other educational environments across the State.

This primarily will be accomplished by aligning our efforts with the State and National Right to Read Program. This program has as its goal the development of a zero defect system where 99 percent of the school population would achieve literacy. With over 70 percent of the State's school districts currently enrolled in the Right to Read Program, a highly effective administrative and technical assistance structure already exists which is devoted to this goal of preventing reading failure.

The philosophical base around which this program is developed is one of mastery and the continuous progress system of education. Current educational systems view time and curriculum as constants with learning achievements as the variable. The Right to Read program believes time and curriculum to be the variables with learning achievement as the constant.

The implications of this program are many for students, educators, and administrators. Reading curricula which are a part of the Right to Read program are sequenced to avoid failure. The student learns what he needs to learn first in order to progress to other facts, skills and attitudes.

The language of instruction becomes one of teaching to learn. Through criterion referenced tests and record keeping, educators and administrators know what each student has been taught as well as what each student has learned. They know if gaps in an individual student's education exist.

They know how far a student has progressed so that the next teacher will know where to begin instruction.

The application of computer technology to continuous progress education will enhance it further by providing the tools for more effective instruction, monitoring and record keeping. The success of the program outlined in the HEW proposal will demonstrate in a dynamic way the extraordinary value of the computer in special education. Having built this program into the larger framework of Right to Read, these results will then be transferable to all the Right to Read schools in the state and eventually in the nation.

It is anticipated that portions of the courseware developed under this grant will be available for the prposed program for handicapped children. Designed specifically for the SLD population, it will make a major contribution to the equal educational opporutnity of disabled learners. In addition to the materials from the SLD grant, assistance from the developers of the materials will ensure close coordination of the two projects.

Law Enforcement Assistance Agency Project (LEAA)

In a combined effort, the State Department of Corrections, the Minnesota Educational Computing Consortium (MECC) and Control Data Corporation applied for and received funds to implement CAI activities in language arts, mathematics, and vocational awareness in two correctional facilities for juvenile retention within the State.

Control Data PLATO terminals have been installed in the Red Wing Training School, Red Wing, Minnesota for use by a selected group of young delinquents who will have access to the materials on the computer. MECC facilities will be installed in Sauk Centre where similar procedures will be implemented.

The goal of this effort is to compare CAI with traditional methods of education for increasing motivation and skills in this segment of the population.

Once again, close contact will be maintained between project teams to prevent duplication of effort and to ensure maximum use of resources. Data accumulated from all three projects will be invaluable in the future for meeting the special educational needs of the total population.

Neither computer technology, computer assisted instruction, computer managed instruction, nor computer based instruction is a panacean solution to all of the problems of education. It is no substitute for good sound instructional programs. There is no single solution to this problem because the basis for difficulties vary from student to student. The answer is in the process. A carefully managed program of alternative strategies and techniques is essential in meeting individual student needs. The solution is going to require a marriage of education and technology, the schools and industry, and humanity with structure.

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